The first 12 problems are true/false. They are worth 3 points each. The next 16 are multiple-choice. They are worth 4 points each. There are 2 bonus problems. Each is worth 2 points. There are tables attached to the back of this exam. You can either use these or your calculator. In computational problems, if your answer is not exactly equal to one of the choices AND you have the right answer, there should be a choice that is very close to yours. There will be only one such choice. You should select this one.

**True/False Section: (Answer A for True; Answer B for False.)**

1. The risk of a Type I error is directly controlled in a hypothesis test by establishing a level for \( \alpha \).

2. If a hypothesis test concerning a population mean is conducted at a level of significance equal to 0.05, then the probability of a Type II error equals 0.95 for any value of \( \mu \) associated with the alternative hypothesis.

3. If the noncritical region in a hypothesis test is made wider (assuming \( \sigma \) and \( n \) remain fixed), then \( \alpha \) becomes larger.

4. The \( t \)-distribution approaches the normal distribution as the number of degrees of freedom increases.

5. As \( n \) becomes larger, the value of \( t(n-1, \alpha /2) \) becomes closer and closer in value to \( z(\alpha /2) \).

6. Suppose you are estimating a proportion. The most conservative estimate for a sample size needed for a given width is given by setting \( p=0.5 \).

7. When random samples are drawn from a normal population of a known variance \( \sigma^2 \), the quantity \( (n-1)s^2 / \sigma^2 \) possesses a probability distribution that is known as the chi-square distribution, with \( n-1 \) degrees of freedom.

8. In constructing a confidence interval for the mean difference in paired data we see that as the sample size increases the width of the interval also increases.

9. The number of degrees of freedom for the critical value of \( t \) is equal to the smaller of \( n_1-1 \) or \( n_2-1 \) when making inferences about the difference between two independent means for the case when the degrees of freedom is estimated.
10. In the hypothesis test, $H_0 : p_1 - p_2 = 0$ and $H_a : p_1 - p_2 \neq 0$, concerning the difference between proportions of two independent samples, we are able to compute a pooled observed probability because $p_1$ and $p_2$ are unknown but assumed equal.

11. If a test statistic has a normal distribution then the parameter that we are estimating (or making a hypothesis about) must be the value of a random variable that has a normal distribution.

12. Suppose $X$ has a chi-squared distribution. Then $P(X > 1) = P(X < -1)$.

**Multiple-Choice Problems:**

13. Suppose you selected 200 different samples from a large population and used each sample to construct a 0.95 confidence interval estimate for the population mean. How many of the 200 confidence interval estimates should you expect to actually contain the population mean $\mu$?

   A. 200
   B. 190
   C. 100
   D. 95

14. What value is always located at the center of a confidence interval for $\mu$?

   A. $E$
   B. $\mu$
   C. $\bar{x}$
   D. $\sigma$

15. Suppose we were testing the hypothesis, $H_0 : \mu = 76.9$ vs. $H_a : \mu \neq 76.9$, using $\alpha = 0.05$. Suppose further that $\sigma = 14.6$. What is the smallest sample size that would cause us to reject the null hypothesis if the sample mean is 74.8?

   A. 174
   B. 186
   C. 196
   D. 208
   E. Can’t be calculated from this data.
16. Find the level of confidence assigned to an interval estimate of the mean formed using the interval: $\bar{x} - 1.96 \cdot \sigma_x$ to $\bar{x} + 1.96 \cdot \sigma_x$

A. .75  
B. .925  
C. .90  
D. .95  
E. .975

17. Find the value of $\bar{x}$ for: $H_0: \mu = 320, \; \zeta^* = 2.6, \; \sigma = 21, \; n = 60$.

A. 326  
B. 327  
C. 323  
D. 321  
E. 372

18. In a two-tailed test, with $n = 20$, the computed value of $t$ is found to be $t^* = 1.85$. Assuming the sample is randomly selected from a normal population, then the $p$-value is given by:

A. $0.005 < p$-value $< 0.01.$  
B. $0.01 < p$-value $< 0.02.$  
C. $0.025 < p$-value $< 0.05.$  
D. $0.05 < p$-value $< 0.10.$
19. The mean age of 25 randomly selected college seniors was found to be 23.5 years, and the standard deviation of all college seniors was 1.3 years. The correct symbol for the 1.3 years is which of the following?

A. \( \mu \)
B. \( s \)
C. \( \sigma \)
D. \( \bar{x} \)

20. The standard deviation of the sampling distribution of the sample binomial probability \( p' \) is:

A. \( p \)
B. \( np \)
C. \( \sqrt{npq} \)
D. \( \sqrt{pq/n} \)
E. \( \sqrt{pq}/n \)

21. A sample of size \( n = 14 \) is selected from a normal population to construct a 95% confidence interval for a population mean. The following interval is obtained: (7.82 to 9.64). Find the sample standard deviation.

A. 1.56
B. 1.76
C. 1.96
D. 2.2
E. 1.21
22. Determine the appropriate size, \( n \), if you want to estimate the number of homes with a computer to be within 0.03 with 90% confidence.

A. 22  
B. 1068  
C. 11  
D. 608  
E. 757

23. A one-tailed hypothesis test for the standard deviation is to be performed. The null hypothesis is that \( H_0 : \sigma = 10 \) and the alternative is \( H_a : \sigma < 10 \). A sample of size 15 and a level of significance equal to 0.05 is to be used. Give the critical region for the test statistic \( T \) for this test.

A. 0 to 6.57  
B. 6.57 to infinity  
C. 23.7 to infinity  
D. 0 to 23.7  
E. 25 to infinity

24. When constructing a confidence interval for the mean difference in paired data, which of the following symbols indicates the middle point of the interval?

A. \( \mu_d \)  
B. \( \sigma_d \)  
C. \( \bar{d} \)  
D. \( s_d \)
25. The sampling distribution of \( p_1' - p_2' \) is approximately normally distributed with a mean equal to:

A. \( p_1 - p_2 \)
B. \( \frac{n_1 p_1 - n_2 p_2}{n_1 + n_2} \)
C. \( \sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} \)
D. 0

26. Ten men compared two brands of razors. One side of the face was shaved by brand A, and the other was shaved by brand B. A “smoothness score” (from 1 to 10) was given by each person for each side. The side on which a given shaver was used was assigned by the flip of a coin. Using the following scores, find the value of the appropriate test statistic.

<table>
<thead>
<tr>
<th>Razors</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand A score</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Brand B score</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

A. 1.52
B. 1.73
C. 1.96
D. 2.36
E. Can’t be done given the information.
27. A survey was conducted to compare the mean cost of a meal at fast food restaurants in two different cities. With the data below, set a 90% confidence interval on $\mu_1 - \mu_2$.

<table>
<thead>
<tr>
<th>City</th>
<th>$n$</th>
<th>$\bar{x}$</th>
<th>$s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A$</td>
<td>40</td>
<td>$4.05$</td>
<td>$0.55$</td>
</tr>
<tr>
<td>$B$</td>
<td>35</td>
<td>$4.85$</td>
<td>$0.85$</td>
</tr>
</tbody>
</table>

A. (.0, 1.87)
B. (.68, .92)
C. (.79, .80)
D. (.75, .85)
E. (.54, 1.10)

28. In a survey of college students, one of the questions asked was “Have you ever cheated in a test??” Two hundred male and 200 female students were asked this question. Thirty percent of the male and 25% of the female responded “yes.” What is the p-value of the test statistic for the hypothesis that there is no difference in the proportions?

A. .2628
B. .027
C. .5
D. .25
E. .3

**Bonus Problems:**

29. True or False: If the significance level of a test is .05, the power is .95.

30. True or False: The power of a test almost always increases if the standard deviation of the test statistic increases.